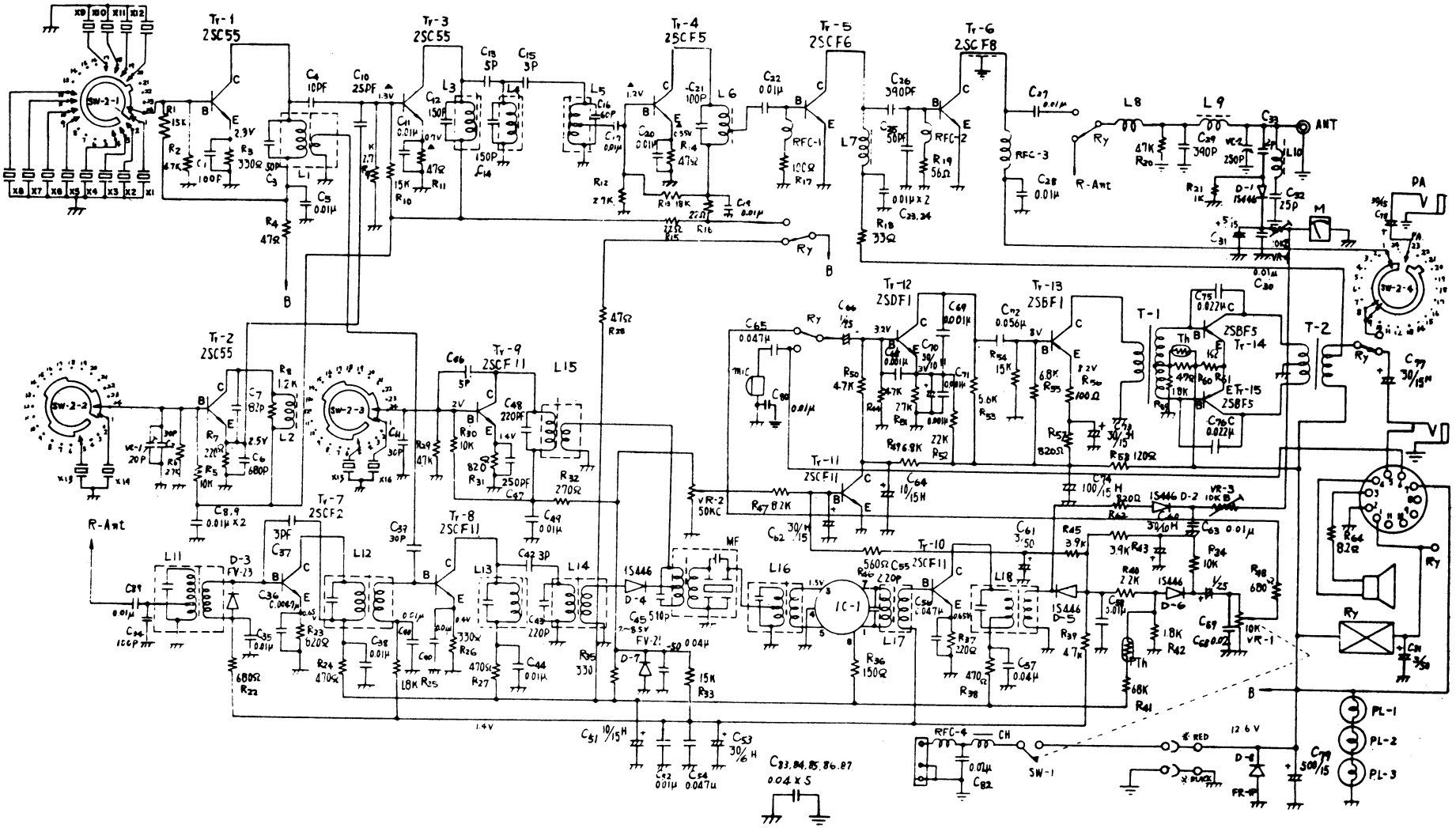
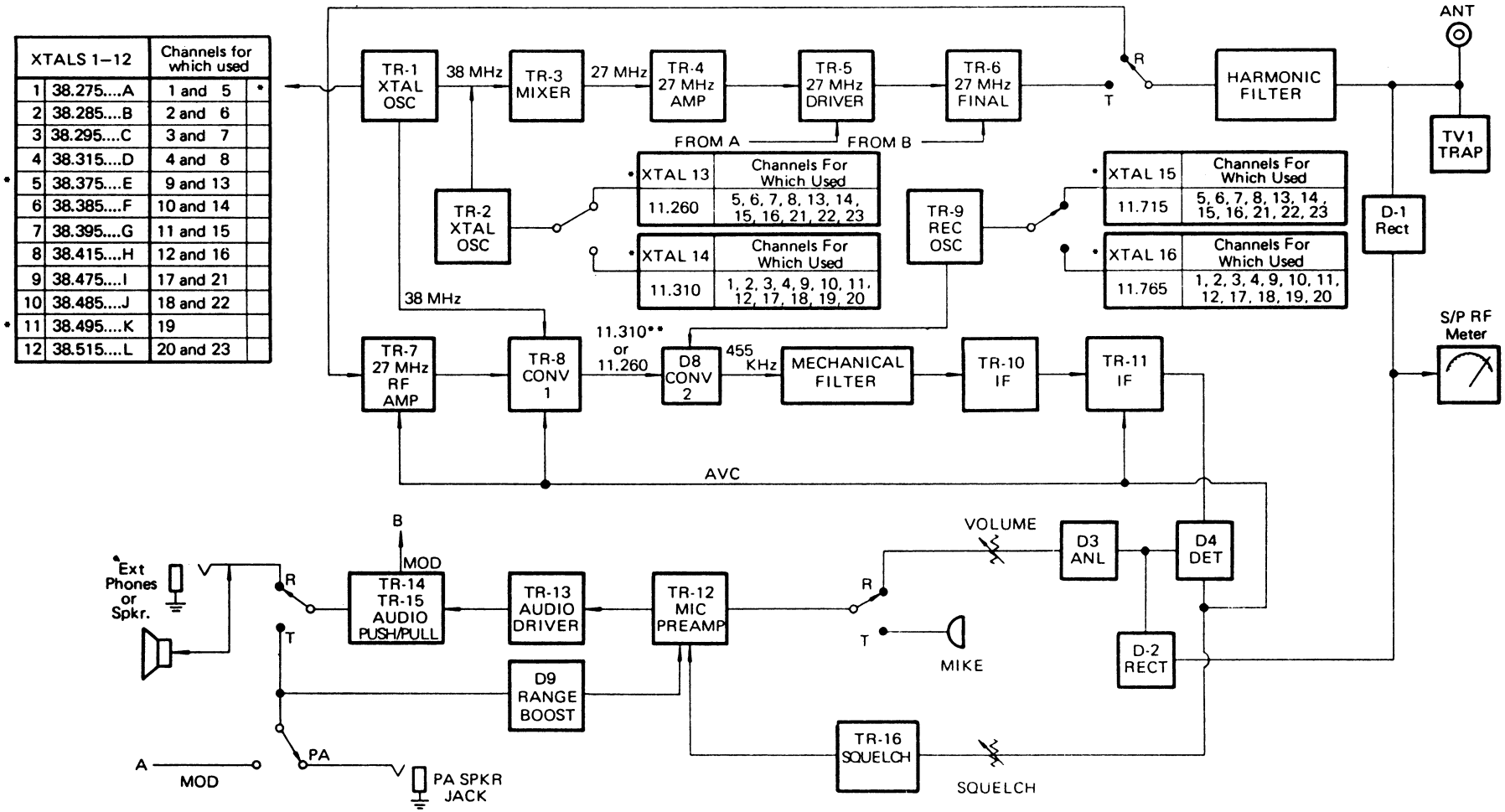
LAFAYETTE HB23





* These crystals inserted at factory for transmit/receive operation on channels 9, 13, and 19, and are permanently wired into circuit except for Xtal 5 (38.375 MHz) which is plugged into socket E.

**1st IF is 11.310 on channels 1, 2, 3, 4, 9, 10, 11, 12, 17, 18, 19, 20.
1st IF is 11.260 on channels 5, 6, 7, 8, 13, 14, 15, 16, 21, 22, 23.

FUNCTIONAL BLOCK DIAGRAM

SERVICE AND MAINTENANCE

This section contains information that will be helpful to a qualified technician in the maintenance and repair of this transceiver. It includes a technical description of the frequency synthesizer circuit, complete alignment procedures for the transmitter and receiver sections, plus a functional block diagram and circuit diagram for the transceiver.

CRYSTAL SYNTHESIZING SYSTEM

GENERAL

This transceiver incorporates a frequency synthesizing system which employs 16 crystals to produce 23 transmitting channels and 23 receiving channels. This represents a great reduction in the number of crystals required when compared to systems which employ one transmit crystal and one receive crystal for each channel (this system would require 46 crystals for 23 channel coverage). The system used in the HB-23A is unique in its operation, even when compared to other frequency synthesizing circuits. Firstly, 10 of the crystals are optional plug-in types and not permanently wired into the circuit (11 crystals are actually plug-in types, but one crystal is factory-installed). Secondly, the circuit has been so designed as to permit the future addition of these 10 crystals (one at a time, if desired) to activate additional channels. This makes it possible to supply the transceiver working on three basic channels (9, 13 and 19), allowing the owner to activate additional channels at any future time, as desired. This arrangement offers the advantage of reduced initial cost without sacrificing the main advantage that frequency synthesis provides, namely, low total crystal cost for multiple channels. Each of the 10 optional crystals activates 2 transmit and 2 receive channels, as shown in Table B. With the insertion of all 10 crystals, 20 additional channels are added to the 3 basic operating channels to provide full 23 channel transmit/receive operation.

Finally, the frequencies of the crystals employed in the system were chosen only after long, exhaustive tests had been carried out with literally tens of thousands of possible combinations to determine which frequencies would provide the least problems from undesired spurious radiations. In addition, special care was taken in the circuit design and manufacture of crystals to ensure high accuracy of frequency – carrier deviation will always be well within FCC requirements on any channel.

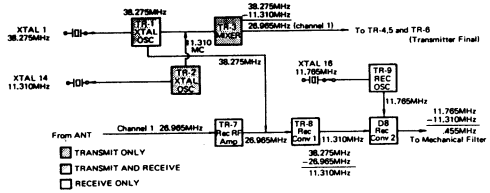


FIGURE A.

Operation of the frequency synthesizing system in transmit and receive modes on channel 1. Note that XTAL 1 and XTAL 14 are used to produce the channel frequency during transmit. During receive, the XTAL 1 frequency is mixed with the incoming signal to produce the 1st IF of 11.310 MHz; the frequency of XTAL 16 is mixed with 11.310 MHz at D8 to produce the 2nd IF of 455 KHz.

SYSTEM DESCRIPTION

In order to understand the manner in which the system operates, it is first necessary to know which crystals are selected for each channel. This information is provided in Table A and in the functional block diagram of the entire transceiver. Figure A is a partial block diagram showing the various frequency conversions that take place during transmit and receive on channel 1 (26.965 MHz). Table A shows that the crystals use in the transmit mode are Xtal 1 (38.275) and Xtal 14 (11.310), and those used in the receive mode are Xtal 1 (38.275) and Xtal 16 (11.765).

In the transmit mode, TR-1 is connected to Xtal 1 and TR-2 is connected to Xtal 14. The output frequencies of these two crystal oscillators (38.275 and 11.310 MHz respectively) are fed to the mixer stage TR-3. The output of the mixer stage contains tuned circuits which will only pass frequencies in the 27 MHz range. Thus, only the difference frequency (38.275 – 11.310 = 26.965 MHz) is applied to TR-4, etc. This system of "beating" of two crystal frequencies takes place on every channel, the appropriate pair of crystals (for TR-1 and TR-2) being automatically selected in each case to produce a difference frequency which is the channel frequency.

In the receive mode, the output of TR-1 (38.275) is mixed with the incoming signal of 26.965 (which has been passed through RF amplifier TR-7).

The output of the converter TR-8 contains tuned circuits which will only pass frequencies in the 11 MHz range. Thus, only the difference frequency (38.275 – 26.965 = 11.310 MHz) is applied to the following stage, D8. TR-9, which has been automatically connected to Xtal 16 when channel 1 was selected, produces an output frequency of 11.765 MHz which is also fed to D8. The output of D8 contains a sharply tuned mechanical filter which will only pass 455 KHz, this being the difference of the two frequencies (11.765 – 11.310 = 455 KHz). This system of converting the incoming frequency twice to produce a second IF of 455 KHz takes place on every channel, the appropriate pair of crystals (for TR-1 and TR-9) being automatically selected in each case. It should be noted that because of the particular frequencies chosen for Xtals 1-12, the difference frequency at the output of TR-8, or 1st IF, will be either 11.310 (as in the case of channel 1) or 11.260 MHz, depending on channel in use (see block diagram of HB-23A).

Table B above shows the operating mode and number of channels for which each of the 16 crystals is used (this includes the 10 optional plug-in crystals). This information is identical to that found in Table A except that it is presented in a form suitable for pin-pointing the failure of a crystal. For example, failure of crystal 14 will cause the transmitter to be inoperative on channels 1, 2, 3, 4, 9, 10, 11, 12, 17, 18, 19 and 20, although the receiver will function normally on these same channels. When malfunctions occur on a selective number of channels in this manner, failure of a crystal or its associated wiring should be suspected initially. Location of all crystals (or sockets) is provided in a diagram showing the interior of the transceiver (on a succeeding page).

TABLE B

XTAL NO.	Socket	FREQUENCY	CHANNELS FOR WHICH USED	
			TRANSMIT	RECEIVE
1	A	38.275	1 and 5	1 and 5
2	B	38.285	2 and 6	2 and 6
3	C	38.295	3 and 7	3 and 7
4	D	38.315	4 and 8	4 and 8
5*	E	38.375	9 and 13	9 and 13
6	F	38.385	10 and 14	10 and 14
7	G	38.395	11 and 15	11 and 15
8	H	38.415	12 and 16	12 and 16
9	I	38.475	17 and 21	17 and 21
10	J	38.485	18 and 22	18 and 22
11*	K	38.495	19	19
12	L	38.515	20 and 23	20 and 23
13*		11.260	5, 6, 7, 8, 13, 14, 15, 16, 21, 22, 23.	------
14*		11.310	1, 2, 3, 4, 9, 10, 11, 12, 17, 18, 19, 20.	------
15*		11.715	------	5, 6, 7, 8, 13, 14, 15, 16, 21, 22, 23.
16*		11.765	------	1, 2, 3, 4, 9, 10, 11, 12, 17, 18, 19, 20.

* Transceiver is factory-equipped with these crystals; all others are plug-in types available as optional extras.

Table B above shows the operating mode and number of channels for which each of the 16 crystals is used (this includes the 10 optional plug-in crystals). This information is identical to that found in Table A except that it is presented in a form suitable for pin-pointing the failure of a crystal. For example, failure of crystal 14 will cause the transmitter to be inoperative on channels 1, 2, 3, 4, 9, 10, 11, 12, 17, 18, 19 and 20, although the receiver will function normally on these same channels. When malfunctions occur on a selective number of channels in this manner, failure of a crystal or its associated wiring should be suspected initially. Location of all crystals (or sockets) is provided in a diagram showing the interior of the transceiver (on a succeeding page).

ALIGNMENT PROCEDURE

The transceiver has been fully aligned at the factory before shipment to you and does not normally require further adjustment. When necessary, however, the receiver and transmitter may be aligned as indicated.

Only qualified technicians with proper test equipment should undertake realignment or tuning adjustments of either the receiver or transmitter sections. It should also be noted that FCC regulations require that all transmitter adjustments be made by, or under the supervision of a person holding a 1st or 2nd class commercial radiotelephone license.

COVER REMOVAL

1. Remove mounting brackets, etc.
2. Turn unit upside-down with speaker grille facing upward. Remove the two upper screws on each side of the unit. Detach the speaker-mounted cover carefully because the speaker is connected to the main chassis by means of two leads terminated with push-on lugs.
3. Refer to the diagram of the interior layout of the unit for location of all adjustment points.

   CAUTION: Most of the coils in this unit have been sealed with wax. Be sure to melt any wax before attempting any adjustment.

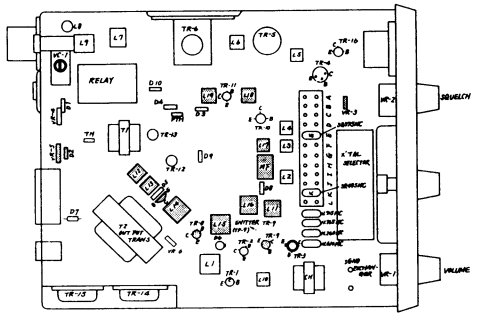
TRANSMITTER ALIGNMENT

Connect a 50 ohm wattmeter to the antenna connector on the transceiver. Connect the microphone to the transceiver and set channel selector to 13. Apply power to transceiver (12.6 volts DC).

38 MHz OSCILLATOR (TR-1)

This oscillator is used for both receive and transmit functions of the transceiver.

1. Connect a DC VTVM between the emitter of TR-1 and ground.
2. Depress push-to-talk button on microphone and rotate the core of L1 clockwise to the bottom of the coil (maximum inductance).
3. Rotate the core of L11 counter-clockwise to the top of the coil (minimum inductance).
4. Now turn core of L11 in a clockwise direction until the oscillation begins. This will be indicated by a reading on the VTVM.
5. Turn core 1/2 turn more in a clockwise direction. VTVM should now read approximately 1.5 volts.



11.260 MHz AND 11.310 MHz IF ALIGNMENT

1. Connect signal generator to the base of transistor TR-8.
2. Connect AC VTVM to speaker terminals.
3. Set signal generator to 11.285 MHz (± 1 KHz).
4. Adjust L15 and L16 for maximum output as read on VTVM. Reduce signal generator out-put as necessary to keep the VTVM reading around 0.5 volts.

RF ALIGNMENT

1. Connect signal generator to antenna connector.
3. Now rotate the core of L1 in a counter-clockwise direction until oscillation begins. This will be indicated by a reading on the VTVM.
4. Turn the core 1/2 turn more in a counter-clockwise direction. VTVM should now read approximately 2.3 volts.

11 MHz OSCILLATOR (TR-2)

1. Connect a DC VTVM between the emitter of TR-2 and ground.
2. Depress push-to-talk button on microphone and rotate the core of L10 counter-clockwise to the top of the coil (minimum inductance).
3. Now ratate the core of L10 in a clockwise direction until oscillation begins. This will be indicated by a reading on the VTVM.
4. Turn the core 1/2 turn in a clockwise direction. VTVM should now read approximately, 2.5 volts.

27 MHz TRANSMITTER STAGES

1. Depress microphone button and adjust cores of L2, L3, L4, L5 and L6 for maximum on the wattmeter.

   NOTE: Adjustment of L5 is fairly critical. Misadjustment of this coil can reduce the transmitter output to zero.

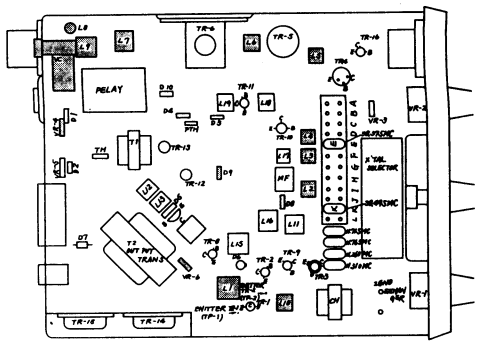
2. Check power output on 9, 13 and 19 channels. If low on some channels, readjust L2, L3, L4, L5 and L6 for equal output on channels 9 and 19.
3. Adjust L7, L8 and VC for maximum output on the wattmeter.

   NOTE: L7 is adjusted by either compressing or expanding the coil turns. Use a non-metallic tuning tool to spread the wire turns.

4. Adjust VR-4 so that transceiver meter reads the same as on the wattmeter.
5. The transceiver may be repeaked for maximum RF power output at the actual installation with the antenna connected by re-adjusting VC-1 for maximum radiated power on an RF field strength meter.

TVI ADJUSTMENT

1. Use a TV receiver set to channel 2 as an indicator.
2. Depress transceiver microphone button and adjust L9 (rear of transceiver) for minimum interference on TV receiver.



455 KHz IF ALIGNMENT

1. Connect signal generator to cathode of D8.
2. Connect AC VTVM to speaker terminals.
3. Set signal generator to 455 KHz ± 0.5 KHz.
4. Apply power to unit and adjust signal generator output to produce a reading of 0.5 volts on the AC VTVM.
5. Adjust mechanical filter (MF), L17, L18 and L19 for maximum output on VTVM.

   NOTE: Reduce output of signal generator as necessary to keep VTVM reading around 0.5 volts.

RECEIVE OSCILLATOR ALIGNMENT (TR-9)

1. Connect a DC VTVM between the emitter of TR-9 and ground.
2. Connect AC VTVM across speaker terminals.
3. Set signal generator to 27.115 MHz, modulated 30% with a 1 KHz tone. Set signal generator output to 10 μV.
4. Set transceiver to channel 13 and vary signal generator frequency around 27.115 MHz to produce a maximum reading on the AC VTVM. Leave generator at this point.
5. Adjust L12, L13 and L14 to produce maximum output on AC VTVM.
6. Reduce generator output to approximately 1 μV. Adjust L12, L13, L14, L15, L16, MF (mechanical filter), L17, L18 and L19 for maximum reading on VTVM. Repeat until no further improvement is noted.
7. Increase generator output to 100 μV and adjust VR-5 so that transceiver meter reads "S-9".
8. Squelch alignment

   Receive signal with signal strength of 80 db from signal generator, and turn squelch control full clockwise then adjust VR-3 until signal is heard.

RETURNING THE UNIT FOR SERVICE

If trouble develops in the transceiver and you wish to return the unit for repair (either in or out of warranty), we recommend that you return the receiver to the Lafayette store from which it was purchased. If the unit is to be shipped to our main office for service, please read the instructions which follow.

Shipping Instructions

Pack the unit very carefully to avoid damage in transit, preferably in its original carton. If the original carton is not available, use a sturdy carton with at least 3 inches of shredded paper or excelsior around the unit. In the latter case, wrap the unit in paper first to avoid particles of packing material getting into it. Include with the unit a letter explaining exactly what difficulties you have encountered (remember to add an extra 5 postage and indicate on the outside of the carton that First Class Mail is enclosed). Ship by prepaid express if possible and mark ELECTRONIC EQUIPMENT – FRAGILE. Clearly address the carton as follows: